Milk Protein: A Perfect Reinvented Idea

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Consumers are becoming more aware of the environmental threat posed by livestock. But **what if we could get milk protein, that wasn't from milk? By Henk Hoogenkamp**

The world's future is the (r)evolution of society where animal products are animal-free. This will also be the case for "cow-free milk" which will use milk protein made by cellular biotechnology that entirely takes away the environmental stress.

In a few words: the new technology allows milk protein to be crafted without the help of a single dairy cow. These milk proteins are more nutritious, and environmentally sustainable than factory-farmed proteins.

In truth, this concept is not so new to the global dairy industry. The vast majority of cheeses today are made from using a fermentation-derived rennet enzyme; this is the exact same thing applied now to the cellular-culture generated milk proteins.

The milk of the future will be made without cows. Of course, there is no intention to entirely replace dairy cows, but rather cow-free milk protein should be seen as an answer to the ecological, environmental and animal welfare without sacrificing the benefits of the milk's huge nutritional benefits as well as the important role in many social cultures.

Upstart cellular biotechnology companies aspire to change the traditional game into precision agriculture, encompassing analytics, digitisation and artificial intelligence know-how, to boost productivity as population growth lifts global food demand.

The surge of yeast science application in relation with clean protein production has brought a new vision for products made from dairy, eggs and meat to the threshold of a new post-agricultural revolution. Ultimately this will lead to the creation of a new supply chains in the food industry, which will see major changes in revenue and profit pools for all stakeholders.

MILK WITHOUT THE COWS

Cellular agriculture can be seen as a disruptive technology whose time has come at the right moment. Dairy milk without any cows is the next logical step forward in the mission to create an animal-friendly society with considerably less impact on the environment.

Technologies that genetically engineer yeast to 'brew' animal cow-free milk can be healthier because the protein does not contain any chemical health disruptive components such as dioxine, hormones, antibiotics and pesticides. It should also be pointed out that the bioengineered yeast does not make it into the end product.

Using natural resources along with innovative technology similar to craft brewing, designer enzymes and yeasts together with plant sugars are incubated via age-old fermentation principles, and blended with plant fats and vitamins and minerals. Animal-free milk is inspired by Mother Nature to recreate what people have been eating for centuries, in a better and more ecologically sustainable way.

ANIMAL-FREE MILK: THE BASICS

Animal-free milk such as that by Berkeley California based dairy-tech start-up Perfect Day Foods provides superior performing milk protein for inclusion in many food and beverage products through a more ecologically sustainable process while significantly reducing the agricultural footprint including the elimination of dairy cows.

Milk and milk protein ingredients such as this are the goodness for more of what is needed and less of what is not. Purer protein and no lactose, unlocked with revolutionary science providing sustainability and no use of overmilked cows.

CONCEPTUALISATION

Pezibear

Cellular milk protein ingredients are a source of nutrients for lasting wellbeing and non-GMO bovine proteins made through sustainable fermentation technologies using modulated yeast and funghi and sugar as the growth accelerator.

The milk proteins are created without animals by using microbes like bacteria or yeast or funghi (the same organisms used today to make rennet). The proteins generated by this technology have the exact same structure and nutritional profile as traditional food milk proteins harvested from dairy cows.

In very basic terms, the yeast and sugar as an 'energy' vehicle are brought together in a fermentation tank resulting in casein or whey protein. This process can create not only micelle casein, but also other types of milk protein such as lactoalbumin and lactoglobulin, and ultimately also total milk protein.

Typically a protein gene is inserted into a starter culture microbe. This enables the microbe to produce identical original products such as cows' casein—a milk protein derivative. Once the starter culture is created, the inserted protein gene into the microbe will be able to multiply and grow. An example of a traditional product created using cellular biotechnology is milk.

This technology allows cow-free milk using a culture that uses simple sugars to make milk protein such as whey protein isolate, and specialty proteins such as calcium caseinate for applications in infant nutrition, and a plethora of food products including yoghurt, ice cream, smoothies, nutraceuticals and dietary support such as sports nutrition supplements.

The milk proteins made via biotechnology are non-GMO, simply because none of the yeast used to kick-start the fermentation process remains present in the final ingredient.

REINVENTED TO PROTECT FOOD SECURITY

To foreshadow the concept early in this article, it can be emphasised that cell cultured rennet is more reliable, performance predictable, purer, and significantly less expensive than animal-harvested (traditional) rennet.

To be clear, there is no intention to replace the entire dairy herd, but rather cow-free milk protein should be seen to supplement protein availability and stabilise costs as an answer to improve the ecological, environmental and animal welfare without sacrificing the benefits of the milk's huge nutritional benefits as well as the important role in many social cultures.

Milk crafted without the help of a single cow that truly taste like the real thing is the answer to secure food availability for the rapidly growing global population reaching 9.8 billion people in 2050.

It is a sure thing that dairy cows are already a more sustainable and efficient way than classical beef production made by converting lots of feed and water into animal protein for human consumption. Post-animal biotechnology will stretch the efficiency of dairy cows further and by-pass the udder and use bioreactors to do just the same.

TURTLE SPEED OR ULTRA SONIC?

Similarly to all other functional protein ingredients, enzymes are used to modulate the organoleptic performance and application properties in many food and beverage products. Enzymes are able to modify proteins of any type but to date the solutions tend to be on a broad-ranged and the technological improvements are still incremental rather than radical. To use enzymes effectively, it is necessary to understand the specific molecular properties and what changes that would be required i.e. what to change and what not to change.

There is no doubt that the future will be based on an enzyme technology platform to enable an increased use of plant or animal proteins via transformative change in protein organoleptics, characteristics and performance.

Come to think of it, biotechnology-engineered animal products using cell cultures is nothing new really. Human-identical insulin—to treat diabetic patients—is made using engineered microbes (yeasts or bacteria). Vanillin and rennet are other examples of genetically modified bacteria, fungi or yeast.

Rennet is an essential ingredient for cheese making. In the past, rennet was extracted from the lining of the fourth stomach of young calves. Since the FDA approval in 1990, rennet enzymes have been considered the first genetically engineered product for food, and now are used worldwide by nearly all cheese making companies.

THE PERFECT SOLUTION

Milk produced through biotechnology will contain essential proteins, plant sugars, fats, vitamins and minerals. The DNA sequence of a dairy cow is inserted into yeast cells, the cultures are grown at preset controlled temperatures and concentrations. Once the casein, whey proteins or even total milk proteins are cultivated, the other components such as plant fats, -sugars, vitamins and minerals such as calcium, sodium and potassium can be blended in.

Fat is a major component of milk and besides its importance for flavour contribution and nutrition, various animal and plant sources can be tweaked at the molecular level and emulsified into the beverage.

The same goes for the selection of the sugars. Lactose is one option, but since many children and adults have trouble digesting this disaccharide sugar of glucose and galactose, plant sugar such as low levels of raw cane sugar or coconut sugar or maltose, or for consumers who are avoiding carbohydrates, it could be entirely sugar-free, are valid options as well.